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ABSTRACT

The environmental movement of the 1960s and 1970s caused an increase in special interest magazines on the market and in environmental education programs in the schools. These magazines communicated science and environmental information, which often could not be found anywhere else, to an increasingly sophisticated audience. However, the field of environmental education has not matured because of communication problems and the established knowledge about the communication process has not been used by the environmental educators. Using diffusion theory and the axiomatic theory of cognition and writing, science communication can be analyzed. For example, science writing offers lengthy explanations that provide too much information for the reader to absorb. Also, science writers often do not sufficiently explain new ideas, thus the audience cannot construct new cognitive structures or restructure old ones. Similarly, the complex nature of the ideas being presented in science writing requires clear and concise writing. The mass media are invaluable to the process of communicating environmental concerns, while science journalists are particularly important, for they must accurately and comprehensively inform the public of events. (SRT)

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SCIENCE COMMUNICATION LESSONS FROM ENVIRONMENTAL EDUCATION

by

Douglas C. Covert

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ABSTRACT

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Diffusion theory and the axiomatic theory of cognition and writing are applied to explain the failure of environmental education to mature as a curriculum in the nation's schools. Some barriers are identified by applying these theories. Growth of new and more sophisticated audiences for writings about science and environmental issues is explained. The theories are then related to science writing to avoid some of the historical communication failures in this arena.

SCIENCE COMMUNICATION LESSONS FROM ENVIRONMENTAL EDUCATION

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Growth of the new environmental movement of the 1960s and 1970s saw the extraordinary rise of two, parallel and closely related phenomena: new and refocussed special interest magazines[1] and environmental education programs in the nation's schools. For science-oriented publications, there are some ramifications to these related phenomena that affect content and emphasis in current and future science writing.

The apparent failure of environmental education to mature has created a newly defined audience, arising out of and adding to the old audiences. With the complexities and scientific uncertainties of environmental discussions and studies, this new audience wants to know what the abundant facts and findings mean to various publics. These readers turn to general interest magazines, especially the news magazines,[2] and interpretive reporting because these sources provide functional information rather than "building-block facts" offered by dedicated science magazines and fact-filled newspaper articles. There also is a rising sophistication that rejects the superficial and sensational.

Magazines have carried the principal burden of communicating to the American people and educating them about science and environmental issues. Newspapers, as well as magazines, reported on environmental issues as they arose, but a newspaper's inherent diversity of topics and emphasis on both breaking news and conciseness do not serve those who sought the "whys" behind the topical issues. Current newspaper science and technology sections now better serve the casual reader seeking somewhat more knowledge and understanding.

While the magazines have attracted considerable interest from a broad range of communicators and communication scholars, environmental education has been the focus of a much smaller group of investigators. The latter have concentrated efforts, for the most part, on development of programs, analysis of means for improving the content and effectiveness of school-associated environmental education, commonly abbreviated EE, and analysis of specific success or non-success.

This paper will explore some theoretically based reasons for lack of success at incorporating the ideals of environmental education into school curricula, as its proponents advocate, and some implications valuable to science writers in the print media. The early emphasis on failure of environmental education to mature is useful as a source of lessons about effective science communication. Analysis will be based principally on Rogers' diffusion theory,[3] supported by the axiomatic theory of cognition and writing by Grunig, Ramsey and Schneider.[4]

Some Background

On a national scale, environmental education stalled, not so much in breadth of adoption, but in its depth. Educators in the environmental movement can point to a number of programs which may be labelled successful, but the fact remains, there is little evidence that their efforts have approached the goal they envisioned of incorporating environmental education throughout the curricula of elementary and secondary schools.

Indeed, the failure to adopt EE is remarkably parallel to the failure of Third World citizenry to adopt innovations. Much of the adoption failure of environmental education is a problem of communication also.[5]

Yet, while the EE movement has achieved only limited curricular success (measuring success by expansion of scheduled teaching activities in the classroom or program incorporation into the regular curriculum), its programs have made substantial contributions over two decades to a greater understanding of the natural sciences in the nation's young people. An important consequence of this non-curricular development is a greater appetite for science information, only partially satisfied by the school classroom or the mass media.

Emergence of Environmental Education

The movement for environmental education in elementary and secondary schools arose from an established base in conservation education. This philosophy had its particular strength in school systems more closely related to rural

environments. Although many antecedents may be identified, the conservation movement begun under president Theodore Roosevelt and the dust bowl days of the 1930s provided signally important boosts to organized conservation education.

A subsequent stage in development was the philosophy of environmental conservation, a label introduced in 1959 by Raymond F. Dasmann with a text of that name. It was a good name for a transition stage and is still strongly supported in some quarters.

Conservation as a label had acquired some disfavor in American society because of its old definition of "wise use," and much of the environmental movement of the 1960s advocated little or no use of at least some resources. "Ecology" retained its identification with the biological sciences. Gradually, other terms were supplanted by "environmental" to signify, essentially, applied ecology considering political, social and economic ramifications and impacts.[6]

Some form of conservation education had existed in non-urban schools for decades, with activities such as school forests, natural history studies and the vital 4-H Youth programs, with a variety of adaptations. The crises of the 1960s broadened the scope and created a need-to-know in the cities as well as in the rural and suburban areas. The old programs based on farms, trees, fields, streams, lakes and wildlife grew with little restraint, finally assuming a broadly based and sensible form in what we now call environmental education. While it spread widely, its scope did not mature;

most programs are not far removed from their earlier forms of outdoor education and natural history.

Maturation Impediments

An earlier effort to identify reasons for non-expansion of EE suggested that diffusion theory could help identify and explain some of the barriers.[7] The stimulus for that analysis and proposal was the research finding that intensive workshop training of classroom teachers of environmental education resulted in no measurable changes in the professional or personal behaviors of those teachers.[8]

Attempts to correlate professional (instructional) behaviors with media usage were generally fruitless. Media use behaviors of one group, a moderately large sample of classroom teachers who had actively demonstrated their interest in improving their abilities as environmental educators, showed a strong interest in magazines focussing on natural history, environmental, scientific and technical subjects. Those surveyed were heavy users of media, especially print. While print and electronic media may have been prime conveyors of information, there was no statistical correlation with attitudes or behaviors before or after the workshop.[9]

Diffusion theory along with the axiomatic theory of cognition and writing offer useful insight into reasons for failure of environmental education to mature. Both help identify and explain adoption barriers and suggest approaches to meeting the needs of the newly developed audiences.

Following are the essential definitions and principles of the two theories.

From diffusion theory:

Attributes of Innovations[10]

1. Relative advantage-- The degree to which an innovation is perceived as being better than the idea it supersedes.
2. Compatibility-- The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.
3. Complexity-- The degree to which an innovation is perceived as relatively difficult to understand and use.
4. Trialability-- The degree to which an innovation may be experimented with on a limited basis.
5. Observability-- The degree to which the results of an innovation are visible to others.

Adoption Stages[11]

1. Knowledge-- exposed to the innovation's existence and gains some understanding of how it functions.
2. Persuasion-- forms a favorable or unfavorable attitude toward the innovation.
3. Decision-- chooses to adopt or reject the innovation.
4. Implementation-- puts an innovation into use.
5. Confirmation-- seeks reinforcement, a continuing process, seeks to avoid dissonance or reduce it if it occurs.

From the axiomatic theory of cognition and writing:

Principles[12]

1. Singularity-- People find it easier to construct or reconstruct one cognitive structure at a time than two or more cognitive structures.
2. Parsimony-- The fewer symbols used to communicate cognitive structures of the same complexity, the more efficiently the person receiving the symbols will be able to reconstruct the cognition.
3. Clarity-- Communication will achieve accuracy and understanding more often when recipients of messages receive symbols that correspond to each element of a cognitive structure or network of structures and the organizational pattern of the messages follows a rule that is apparent to the recipient.
4. Redundancy-- The use of different symbols within the same symbol system or the use of different symbol systems to communicate a cognitive structure increases the frequency with which accuracy and understanding are achieved.

5. Complexity-- The greater the complexity of a cognitive structure or of the schema to which the structure is connected the greater the difficulty of communicating the cognition to someone without an appropriate schema.

6. Low Involvement-- The lower a person's level of involvement in an issue, the greater the effect of Principles 1 to 5 in achieving accuracy and understanding.

7. Reconstruction-- The greater the extent to which communication is used to help construct cognitions, the more the message must be reconstructed, using the five previous principles, if accuracy and understanding are to be achieved.

8. Feedback-- Messages that are produced after a communicator has received feedback from a previous communicative effort will result in greater accuracy and understanding than the first message.

9. Synecdochic-- Symbols that suggest a familiar schema to the recipient of a message evoke complex meaning that is not apparent from the phrase alone to someone who does not have a similar schema.

10. Persuasion-- The greater the number of cognitive structures with implications for attitudes and behavior favored by the persuasive communicator, the greater the likelihood of favorable attitudes and behavior.

11. Attitude Frame-- When a cross-situational attitude--a referent criterion--provides a frame for thought, it is difficult to achieve accuracy and understanding of cognitive structures whose implications for behavior do not fit within that frame.

Some Barriers Identified and Convergence of Two Theories

Environmental education was an innovation in educational practice as were kindergarten and modern math. Newness may be argued since many ancient and not-so-ancient philosophies and religions advocated harmony with one's surroundings. But, the relatively new need for specialized training of teachers in environmental education demonstrated that environmental education was an important departure from educational and social system norms.

Systems have been in place for more than a decade and a half to expose teachers to knowledge of the existence of EE, its purpose in the curriculum and tools available for implementing it. State environmental organizations of several kinds publicized new developments to teachers and the general public. Publishers, established and neophyte, distributed fliers. School districts, environmental groups and publishers held well-publicized workshops. In short, the problems did not lie in the knowledge stage of the adoption process.

The first serious difficulties arose at the persuasion stage. First, little thought was given to the state of knowledge possessed by the teachers expected to become active as EE teachers. Because one of the basic principles of environmental issues is that everything is related to everything else, too many teachers were dismayed by the complexity of the systems they thought they would be expected to learn and then teach about. The pedagogical process was seen as complex because of the "everything is related . . ." principles. The teachers saw many limitations, in the knowledge base and the skills necessary, in themselves and in their pupils, that would preclude effective instruction in such complex subject material.

Further, the teachers saw the environmental movement exhibiting many incompatibilities with the value norms and past experiences of themselves and their pupils that would create intellectual and emotional uncertainties, conflicts with societal standards in their communities and need for cognitive

reconstruction. Uncertainties, of course, produce some degree of fear or avoidance or both.

Compatibility and complexity attributes tended to work against adoption, not necessarily causing an unfavorable attitude, but rather a perception by the individual teacher of a lack of situational realism.

Barriers arose in the school setting, both from inertia, ". . . the more we know about how to do something, the harder it is to do it differently,"[13] and from an approval vacuum in the schools. Teachers are as dependent for approval on their cohorts as any group, with a concommitant fear of network alienation. Persuaders often fail to recognize the need for a potential adopter to persuade both himself and significant others that the innovation is favorable.[14] There is need for continuous confirmation, during the adoption process as well as after.

Also, proponents of EE did not avoid the problems resulting from lack of singularity or parsimony in cognitive structure. Workshops for teachers helped reduce the complexity in communicating cognitive structure for those teachers who attended, but many teachers saw the schema complexity as too difficult to overcome and stayed away from the training sessions.

There was also active resistance to adoption of a new curricular structure. School systems and other teachers saw the new entry into the curriculum as disruptive of established and proven instructional systems, offering no relative advantage to

the school. Teachers would have to learn new subject matter, explain to students and parents the new concepts, and begin to relate all classroom topics under a new umbrella. Parents saw EE as a further departure from the three Rs and considered it a luxury that had little or no direct value to their children in achieving success after graduation. Teachers advocating EE tended to receive feedback that was at least discouraging if not in opposition.

Even individual teachers who had embraced and actively adopted EE had cognitive and pragmatic difficulty. The breadth of the concepts were daunting to teacher and pupil, there was often too little opportunity for relating principles to real life encounters (low involvement), and established attitude frames made cross-situational reference unlikely and, when possible, uncertain or inexact.

As a consequence of these problems, even those teachers who decided to adopt EE often found reversion to older curriculum structures easier and simpler. Available materials were unitized, thus compatible with trialability. Purveyors also recognized the selling and pedagogical values of bite-sized pieces of instruction.[15] Although under a newer label, teaching old science principles was neater and simpler--easy to understand textbooks were available. Field trips were entertaining and often were led by others. A narrower focus on natural sciences fit better into the unit-of-instruction curricular structure. Instructional materials labelled as environmentally educational were

available in neat packages, used exciting demonstrations, and fit the principles they were intended to teach into the niches which science texts described. These units of instruction were also understandable by administrators and by other teachers, and more acceptable to their institutions as environmental education. With limited incorporation, learning consequences were measurable in a recognized fashion. Peer approval and observability were now possible.

Growth of a New Audience

In spite of its failure, whole or partial, to mature as a curriculum in the school, environmental education generated important peripheral growth in pupils and teachers. Children were now exposed to nature, on their field trips to nature and environmental education centers, and by a growing corps of naturalists with a real concern for the larger environment and less interest in anecdotal natural history, outdoor games and campfire songs. Students were guided to a perspective that included social responsibility, not just use, however wise, fundamental to the old conservation education ethic.

The new science lessons offered under the umbrella label of environmental education demonstrated principles of physics, chemistry, astronomy, zoology, botany and ecology in a more sophisticated and more easily understood fashion than those of customary elementary school science lessons. Science became more exciting and more interesting. The mathematics involved in some of the experiments helped reduce the math anxiety of

pupils in the elementary grades. Schools with even the most basic kinds of EE found students doing more reading of science-oriented books in school libraries and intense interest in science- and environment-oriented magazines.[16]

But, the current crop of magazines tailored to these special interests may not be serving their audiences well. There is evidence that established adult readers in these areas may simply maintain contact with the subject area through publications rather than consume significant portions of the content--the reader may only attend to the occasional article offering new or revised information. Repetition of information may help maintain existing knowledge, attitudes and behaviors without having much other influence. Repetitive content may play a role in limiting the usefulness of special-interest publications. In other words, subscription may support an interest-identity for the individual rather than knowledge gain or communicatory utility.[17] These readers, too, need the attention of the new science writers.

Two additional groups with pressing need for science and environment information have recently developed. Many teachers have been pressed by job demands into the science classroom with little or no science knowledge.[18] The court system--lawyers and judges--is increasingly involved in questions based on science, with the attendant uncertainties and the social, economic and political ramifications.[19]

There is need, then, to serve a broad range of science information seekers. The failure of EE can instruct the new and

the experienced science writer. Environmental education, in the schools and out, tried to provide a wide range of understanding to serve all audiences, supported by the necessary principles and facts. It found itself unacceptable except to a modest cadre. It could not be all things to all audiences and found itself exceeding the capacity of its audiences to cope with perceptions of its complexity. Environmental education ignored a fundamental facet of ecology: that of niches.

One solution to this inability to serve all publics with the same program is to focus on each of the audiences, as magazines attempt to do. Active advocates, or at least participants, may be typified by the teachers and by the judiciary. Teachers, in their classroom activities, have support from texts, periodicals and workshops aimed directly at their instructional needs. They still need, however, information about current developments, projections and interrelationships of facts and principles with society. Judges and lawyers have little opportunity to become expert in scientific or environmental issues, but certainly should understand "the nature of scientific inquiry and debate."[20]

There are also less active audiences, the passive advocates who become active in the polling place and community campaigns, the individuals who acquire knowledge to satisfy intellectual needs, and those who use science-based information to reinforce existing attitudes and behaviors. There are, too, curiosity and sensation seekers, served most aptly by the less serious press.

Science writers need to abandon their traditional concepts of the mass audience for science and more carefully tailor their work to the new, more sophisticated audiences.

There are currently several methodological approaches to study of media consumers and their needs. Shoemaker and Inskip typify the uses and gratifications approach to a science-based group.[21] Several researchers have explored agenda-setting and barriers.[22] Socio-psychological needs have also been investigated.[23]

But, these research findings are only indirectly helpful to the science writer and editor. The new audience, or audiences, for writings in science is more and more prepared for and seeks out interpretation, most commonly found in the news magazines, general-interest science magazines, and the science/technology sections of newspapers. While these publications are improving, they still tend to serve their cohorts more than the new readers and increased sophistication of old readers.

Applying Two Theories

Environmental educators have been unsuccessful in leading their programs to maturity because they did not use established knowledge about the communication process. Science writers and editors should not make the same mistakes. Rogers' diffusion theory and especially the axiomatic theory of Grunig et al. have practical value for science writers and editors.

Many of the common rules for writing lucidly are embodied in the axiomatic theory, but we tend to ignore them when revealing the supposed arcanery of science and the interrelationships of environmental issues. The principles and corollaries of this theory offer a useful checklist.

Lengthy explanations commonly offered by print media science writers tend to violate the principles of singularity, parsimony and clarity. Often, there is simply too much information for the reader to apply to a weak or non-existing cognitive structure. The concise audio-visual spectacle of television is powerful, but rarely does more than introduce the topic or its latest variation. There may be recognition of the topic and its place on the media agenda, but little understanding.

Redundancy and reconstruction are closely allied in science writing. Many writers use redundancy effectively, but forget that new cognitions are not helped by redundancies that are without meaning or without relevance to the reader. New information and new relationships require new construction or reconstruction of old concepts to achieve understanding.

Writers also tend to forget that new information, without a pre-existing base, may be easily perceived as incompatible with past experience, realistic needs and existing value systems. Environmental issues in particular require cross-situational criteria for attitudes or behaviors that do not necessarily fit into existing attitude frames and may therefore be avoided or rejected.

Trial of the information may be required, whether there is low or high involvement in the topic. Describe how the new information fits into the reader's existing grid of knowledge (cognitive grounding) with suggested relationships. ". . . education provides people with ever increasingly complex conceptual maps. These maps are filled in by the media. . . the addition of new concepts demands media capable of providing perspective and interpretation."[24]

Some obvious yet fundamental examples may be needed for some members of the audience to get the point. While for some these examples may seem sensationalistic or trivial, they may be essential to establish cognitive grounding. Physicists and engineers decry the use of water flow in pipes to describe the "flow" of electricity, yet it is the one analogy which anyone (acquainted with indoor plumbing) can easily understand. Some care is needed not to underestimate the reader's intelligence--or give that impression. However, the more familiar a writer becomes with a topic, the more the writer tends to overestimate the reader's knowledge.

Acceptance of information by the nonscientist as well as the scientist is heavily dependent on observability and confirmation. A single source or source-type is often the sole basis for a story about new developments in science. As any good reporter knows, multiple sources and balance are necessary for a sound story, on whatever topic.

The difficulties of writing clearly and concisely about complex subjects are, of course, foremost in the minds of

writers of science-based material. Many are quite successful at unraveling complicated and interrelated topics. Some, however, misinterpret the dictum for lively writing. In composing a colorful story they forget that the true color of language is in the ideas expressed, not the verbiage used in expression. The color of language is often hidden behind a gray veil of excessive adjectives and adverbs.

The new audience's interest in science is often captured by what become media events. While the issues may be dramatized effectively, there is little contribution to the understanding of science in sensationalism, or in carrying the audience beyond what the reader/viewer can accept within existing cognitive and philosophical structures.

The writer needs to show the relative advantage to society and the individual. At the same time, it is essential to avoid presenting scientific and environmental issues in a "Tragedy of the Commons" fashion,[25] creating scenarios interpreted as "no-win" situations or as another version of the Prisoner's Dilemma game. This is a common failing of inadequately trained science writers, or those who come from other arenas--such as crime reporting. Few issues are clear cut and few problems are insoluble if the audience is willing to make small adjustments on a large scale.

Summary

As Friedman, Dunwoody and Rogers put it, ". . . like it or not--science and the mass media are intrinsic to the process by

which nonscientists come to understand (or misunderstand) science."[26] Statements of principles and codes of professional organizations of journalists suggest the responsibilities and roles of science journalists: From the Radio Television News Directors Association, ". . . to inform the public of events of importance and appropriate interest in a manner that is accurate and comprehensive . . ."; from the American Society of Newspaper Editors, ". . . to serve the general welfare by informing the people and enabling them to make judgments on the issues of the time"; and from the Society of Professional Journalists, Sigma Delta Chi, "The public's right to know of events of public importance and interest is the overriding mission of the mass media."

The development of new audiences for science writing, in magazines and newspapers, creates new challenges for writers and editors. Application of philosophical and pragmatic communication theories, such as diffusion theory and the axiomatic theory of cognition and writing, to science writing will provide the kind of interpretation these new audiences can and will use.

NOTES

[1]A. Clay Schoenfeld, "The Environmental Movement as Reflected in the American Magazine," Journalism Quarterly, 60:470-5 (Autumn 1983).

[2]Douglas C. Covert, "Magazine Reading Patterns and Media Evaluations of a Special-Interest Audience." Report to the Association for Education in Journalism, Boston, Mass.: Boston Univ., 1980.

[3]Everett M. Rogers, Diffusion of Innovations, 3rd ed., (New York: The Free Press, 1983).

[4]James E. Grunig, Shirley Ramsey and Larissa A. Schneider, "An Axiomatic Theory of Cognition and Writing." Report to the Association for Education in Journalism and Mass Communication, Corvallis, Ore.: Oregon State Univ., 1983.

[5]Srinivas R. Melkote and Anantha S. Babbili, "The Paradox of the Diffusion of Innovations Research: Creating More Communication Bottlenecks than Breaking Them." Report to the Association for Education in Journalism and Mass Communication, Memphis, Tenn.: Memphis State Univ., 1985.

[6]Douglas C. Covert, "Toward a Curriculum in Environmental Education," Journal of Environmental Education, 1:1, 11-12 (Fall, 1969).

[7]Douglas C. Covert, "Communication Barriers in Environmental Education: Relationship of Diffusion Theory to Evidence of Rejection Decisions." Report to the National Association for Environmental Education, Ypsilanti, Mich.: Eastern Michigan Univ., 1983.

[8]Douglas C. Covert, "Attitudes, Actions and Communication Behaviors of Teachers Before and After Experiencing an Environmental Education Workshop." Ph.D. dissertation, Michigan State Univ., East Lansing, Mich., 1982.

[9]Covert, "Magazine Reading Patterns," p. 13; Covert, "Attitudes, Actions," pp. 66-7.

[10]Rogers, Diffusion of Innovations, pp. 211-32.

[11]Ibid., pp. 163-86.

[12]Grunig, et al., "An Axiomatic Theory," pp. 32-9.

[13]Abraham Kaplan, The Conduct of Inquiry, San Francisco: Chandler, 1964, p. 31.

[14]Gerald R. Miller and Michael Burgoon, "Persuasion Research: Review and Commentary," in Brent D. Rubin, ed., Communication Yearbook 2, New Brunswick, N.J.: Transaction, 1978.

[15]Stanley L. Cummings Jr., "Environmental Education: A Market Survey." Report to the annual meeting of the American Educational Research Association, San Francisco, 19-23 April 1976. ERIC, ED 124415, 1976.

[16]Based on personal interviews with more than 400 teachers of environmental education units, classes or programs in Michigan in 1978, 1979 and 1980.

[17]Covert, "Magazine Reading Patterns," pp. 12-3,19.

[18]Pat Ordovensky, "Science Classes Forced on Untrained Teachers," USA Today, March 28, 1986, p. 4D.

[19]Kenneth S. Abraham and Richard A. Merrill, "Scientific Uncertainty in the Courts," Issues in Science and Technology, 26:2 (Winter 1986) pp. 93-107.

[20]Ibid., p. 106.

[21]Pamela J. Shoemaker and Elizabeth Inskip, "Targeting Audience Subcategories for Specialty Magazines: A Uses and Gratifications Perspective." Report to the Association for Education in Journalism and Mass Communication, Memphis, Tenn.: Memphis State Univ., 1985.

[22]Tony Atwater, Michael B. Salwen and Ronald B. Anderson, "Media Agenda-Setting with Environmental Issues," Journalism Quarterly, 62:393-7 (Summer, 1985); Tony Atwater, Michael B. Salwen and Ronald B. Anderson, "Interpersonal Discussion as a Potential Barrier to Agenda-Setting," Newspaper Research Journal, 6:4, 37-43 (Summer, 1985); Hugh M. Culbertson and Guido H. Stempel III, "Possible Barriers to Agenda Setting in Medical News," Newspaper Research Journal, 5:3, 53-60 (Spring, 1984).

[23]Laurence B. Lain, "More Evidence on the Needs of Readers," Newspaper Research Journal, 6:4, 8-18 (Summer, 1985).

[24]William R. Elliott and William L. Rosenberg, "Opinions about Science and Technology, Social Locator Variables and Mass Media Exposure: A Commonality Analysis." Report to the Association for Education in Journalism and Mass Communication, Memphis, Tenn.: Memphis State Univ., 1985, p. 3.

[25]Garrett Hardin, "The Tragedy of the Commons," Science, 1968: 1,244.

[26]Sharon M. Friedman, Sharon Dunwoody and Carol L. Rogers, Introduction to Scientists and Journalists, New York: The Free Press, 1986, p. xii.